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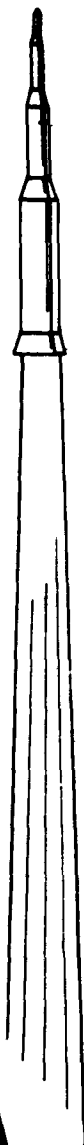
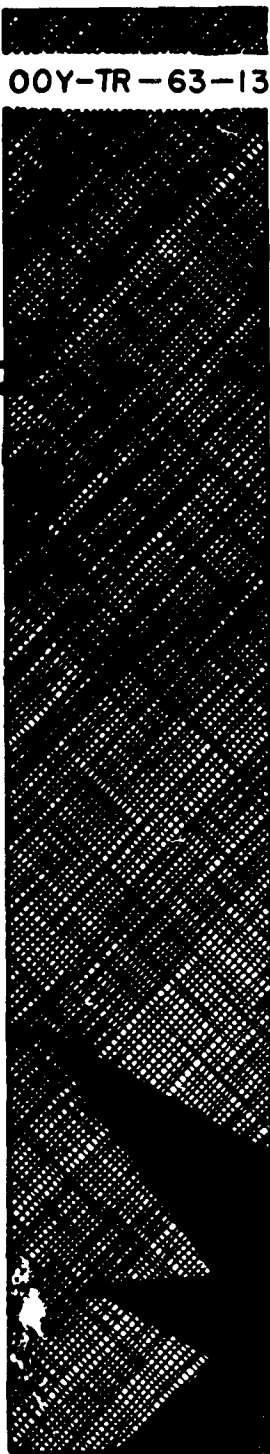
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JUNE 1963

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OOAMA

AIRMUNITIONS TEST REPORT

SERVICE LIFE TEST OF CARTRIDGE
SHACKLE EJECTOR FOR THE
GAM-72 MISSILE

DDC
DEPARTMENT OF DEFENSE



SERVICE LIFE TEST OF CARTRIDGE SHACKLE EJECTOR
FOR THE GAM-72 MISSILE

by

Kenneth A. Kartchner

PUBLICATION REVIEW

This report has been reviewed and is approved



ALEX D. PERESICH
Chief, Engineering and
Test Division
2705th Airmunitions Wing

JUNE 1963

2705TH AIRMUNITIONS WING
OGDEN AIR MATERIEL AREA
AIR FORCE LOGISTICS COMMAND
UNITED STATES AIR FORCE
Hill Air Force Base, Utah

NOTICES

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The conclusions and recommendations made in this report are not to be considered directive in nature. This type information becomes official only when published in Technical Orders and/or other applicable Air Force publications.

ADMINISTRATIVE DATA

PURPOSE OF TESTS:

The purpose of these tests was to verify the tentative one year service life of the Shackle Ejector Cartridge P/N AMF 105-023-1100 and to determine if the service life could be extended.

MANUFACTURER:

American Machine and Foundry Company
7501 North Wacker Avenue
Niles 48, Illinois

MANUFACTURER'S TYPE AND PART NUMBER

P/N AMF 105-023-1100
S/N 1375-894-5692

DRAWINGS AND SPECIFICATIONS:

MAC DWG 44-490052-5
MAC DWG 44-490053-3
AMF DWG 105-023-1100
TO. 21GAM-72-2-5
TO. 21GAM-72-6-1

SECURITY CLASSIFICATION:

Unclassified

DATE TEST COMPLETED:

March 1963

TEST CONDUCTED BY:

OOAMA (OOYET - 2705th Airmunitions Wing)

Test Director: Captain Richard O. Miller

Project Engineer: Kenneth A. Kartchner, Electronics
Engineer

00Y-TR-63-13

DISPOSITION OF SPECIMENS:

All metal parts generated from this operation were inspected certified inert and turned over to the Redistribution and Marketing Division in accordance with AFM 32-6 and HAFER 136-2.

ABSTRACT

These tests were initiated to determine the effects of operational service conditions on the useful life of the Cartridge, Shackle Ejector AMF 105-023-1100. The tentative service life of the cartridge was one year. The cartridges tested were shipped to OOAMA from the various locations in which they had been in service. The actual life in service had not exceeded two years on any of the test cartridges.

The cartridges were fired in a closed chamber having a volume approximately equal to the shackle ejector in locked shut condition.

The average of maximum pressures obtained in the tests were close to those obtained during the qualification test. However, the maximum pressures were more random in nature.

The length of time between firing of the primer and the build-up of pressure in the closed chamber was longer than that obtained during the qualification test.

The results of the tests show that there was a slight decline in performance of the cartridges after two years of operational service. The test data shows that the cartridges which have been installed for two years are still serviceable. It is recommended that the service life of the cartridge be extended from one year to two years.

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INTRODUCTION

The tentative service life of an airmunitions item is set by the Air Force based on the experience and recommendations of the manufacturer. The airmunitions items are then placed in the inventory and in operational service. After expiration of the tentative service life of the items they are brought in for testing. The data from these tests contain information on the condition of the items, and by comparing this data with data from previous tests run by the manufacturer or by the Air Force, trends can be established on which additional service life can be predicted. Any additional extensions of the service life of these items will depend on future tests on this type of explosive item after it has received progressively longer service under operational conditions.

The Shackle Ejector Cartridge Test is a part of a new program in which the aging and test environment for the cartridge is at the operational site. Useful service is being obtained from the items while they are being conditioned.

This test was conducted under Test Directive M-2-572-Y issued in May 1962 by the Air Launch Missiles Branch (00YEA), and necessary tests were performed by the Test Division (00YT), 2705th Airmunitions Wing (00Y).

DESCRIPTION

The Cartridge, Shackle Ejector P/N 105-023-1100, manufactured by American Machine and Foundry is used to supply the gas pressure which operates the Shackle Ejector P/N 105-023-1000.

The cartridge contains two filament bridge wires which have a resistance between 0.1 and 0.15 ohms each. The 100 per cent no fire current is two amperes and the minimum all fire current is three amperes for each bridge wire. During normal operation in the aircraft the two bridge wires are externally connected in parallel. The bridge wires are part of the Navy Mk 42 Mod 5 Primer. This primer ignites a small charge of black powder which in turn ignites the propellant charge. As the propellant charge burns, it produces gas which ruptures the end of the cartridge. A perforated disk in the end of the cartridge restricts the flow of gas into the shackle ejector thus providing better combustion pressures in the cartridge and also preventing any large pieces of propellant from getting into small passages in the shackle ejector. The main part of the cartridge is 1.75 inches long and 1.15 inches in diameter. A photograph of the cartridge is shown in Figure 1, and a section sectional drawing of the cartridge is shown in Figure 2. A comparison of the shackle ejector cartridge and the track jettison cartridge is shown in Figure 3.

The hot gases from the cartridge enter the expansion chamber of the shackle ejector. The expanding gases move the shackle release piston against a small load. The moving shackle release piston uncovers a port near the end of its stroke allowing the gases to bypass to the telescoping piston. The gases move the large telescoping piston against a heavy load to its full extent of travel. When the telescoping piston reaches the end of its travel it uncovers a relief orifice allowing the internal pressure to be relieved. Under some conditions when the action of the telescoping piston is not desired, a special plug is used in its place to retain the gases. The shackle ejector is used to release the GAM-72 Missile from its shackle in the B-52 Aircraft. The configuration of the shackle ejector is shown in Figure 4.

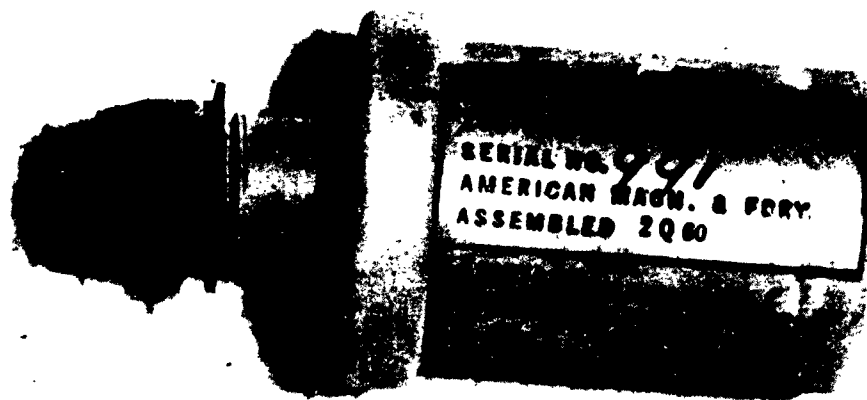


FIGURE 1. Shackle Ejector Cartridge.

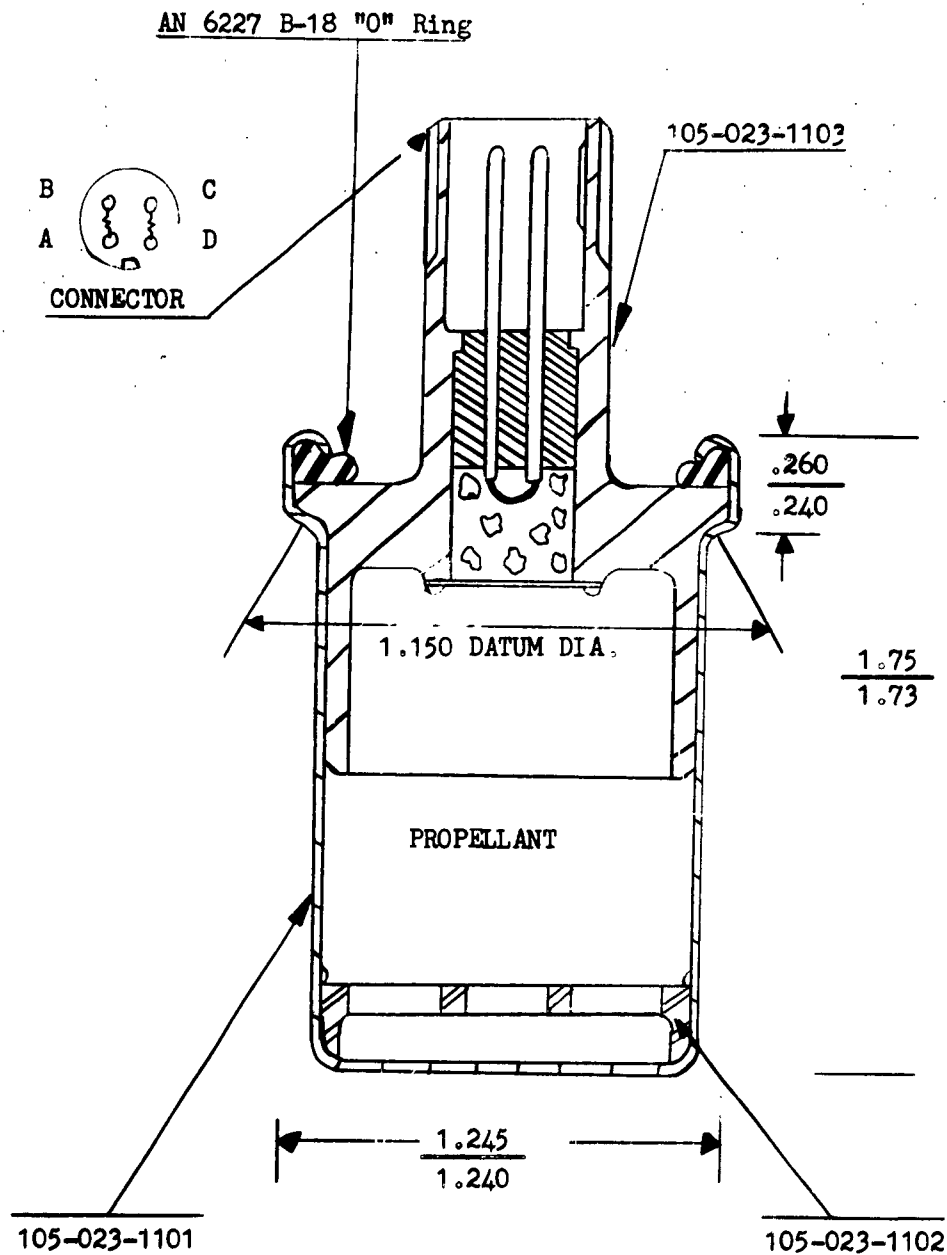


FIGURE 2. Sectional Drawing of Shackle Ejector Cartridge.

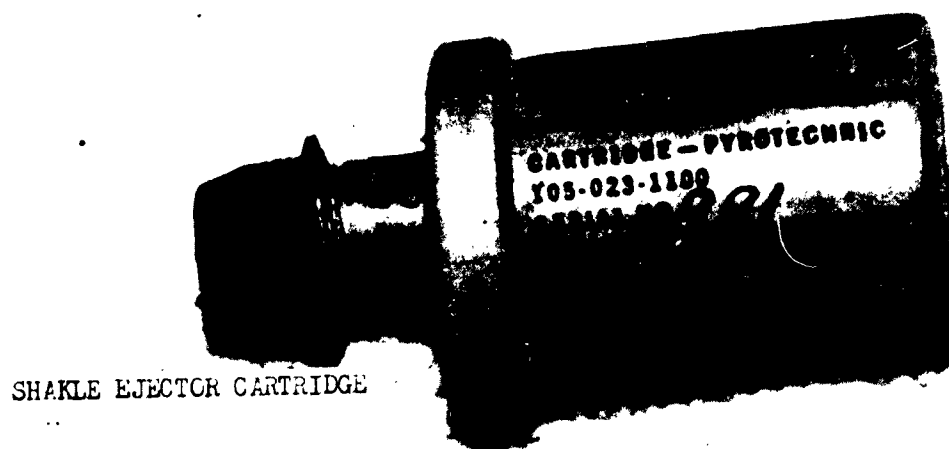
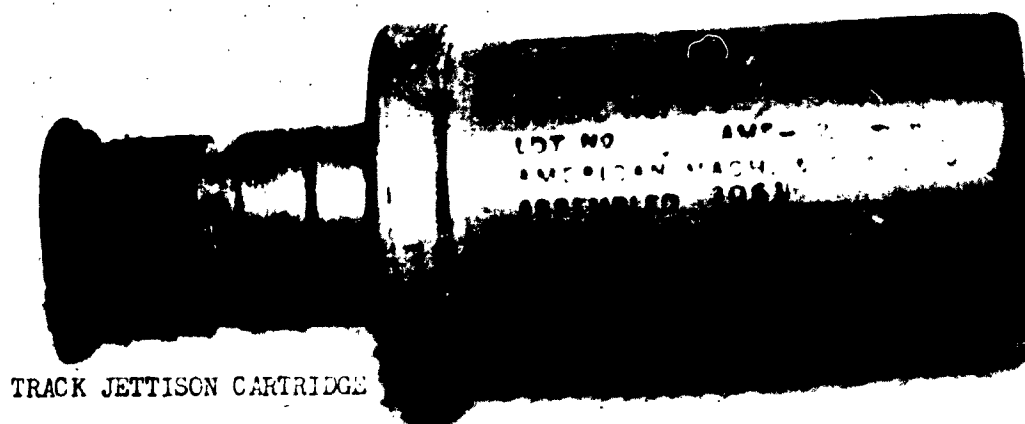


FIGURE 3. Shackle Ejector and Track Jettison Cartridges.

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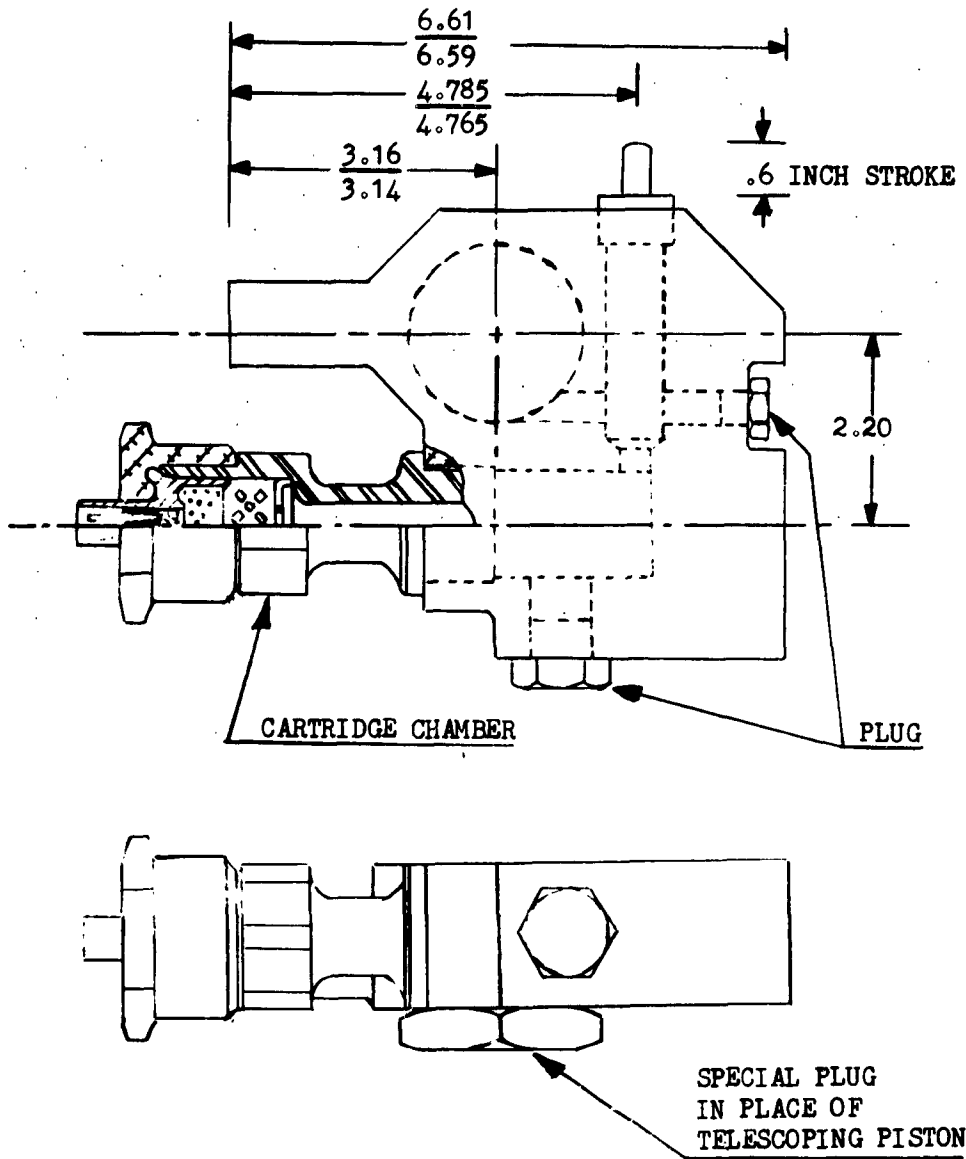


FIGURE 4. Drawing of Shackle Ejector.

EQUIPMENT

The following equipment was used during the performance of this test:

1. Closed test chamber (6.86 cubic inches) designed and built at OOAMA. See Figures 5 and 6.
2. Pressure transducer, (0 to 10,000 psi) Wiancko AM Type, Serial Number 36421.
3. Recorder, Consolidated Electrodynamics Corporation Type 5-116, Serial Number 14009.
4. Demodulator. The following settings were used:
 - a. Channel One.
 - b. Attenuation 14.
 - c. Zero 5.50
 - d. Range "A".
 - e. "B" setting 5.01.
 - f. Polarity Normal.
5. Type 318 Galvanometer was used for pressure trace.
6. Type 319 Galvanometer was used for current trace.
7. Igniter resistance bridge (designed by OOAMA).
8. Firing panel (designed by OOAMA).
9. Cold oven - altitude and temperature chamber, manufactured by Tenney Engineering, Inc. FSN 6685-509-5230.
10. Hot Oven - 7 cubic feet, manufactured by American Instrument Company, Inc.

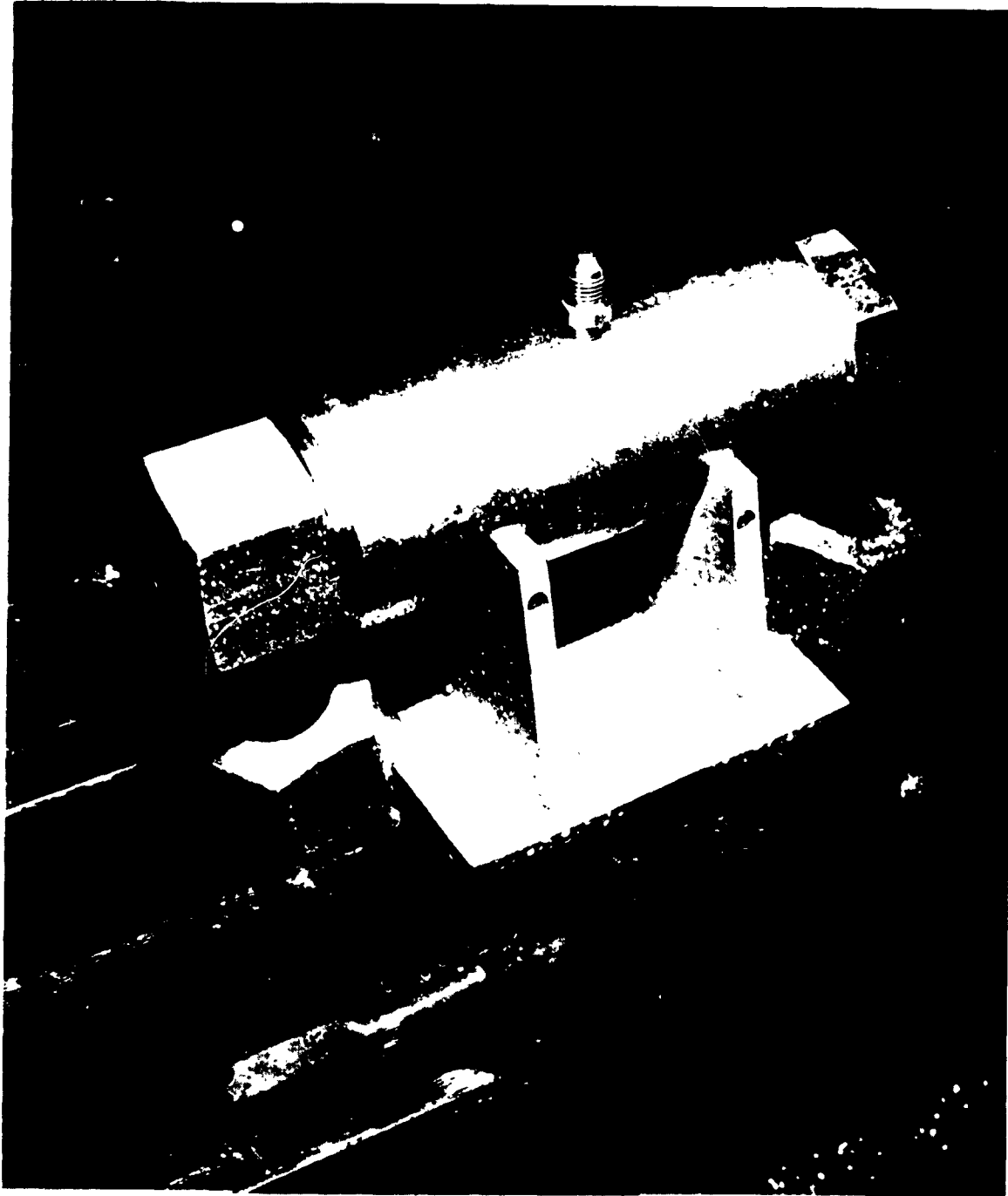


FIGURE 5. Closed Test Chamber.

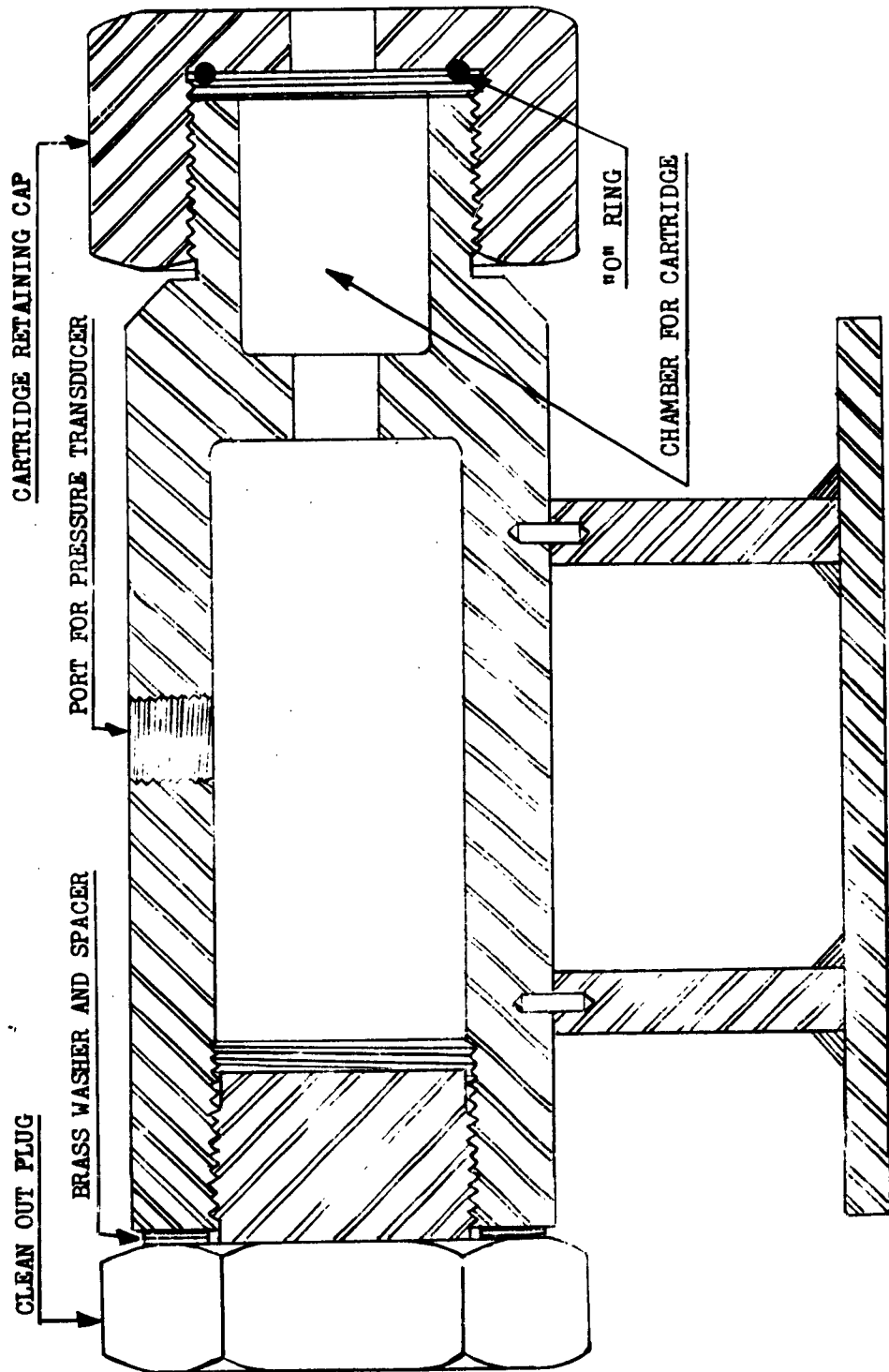


FIGURE 6. Closed Test Chamber 6.68 Cubic Inches.

TEST PROCEDURES

The forty shackle ejector cartridges were shipped to OOAMA from the using activity where they had been subjected to operational service environment for at least one year.

Prior to testing, the forty cartridges were examined visually for rough handling, dents and broken parts.

Twenty-one cartridges were conditioned in the cold oven at -65°F for two hours before functioning. The other 19 cartridges were conditioned in the hot oven set at 165°F for 2 hours before functioning. After conditioning, each cartridge was in turn placed in the 6.86 cubic inch closed chamber and functioned with about 10 amperes of current applied to both bridge wires. The firing current was recorded by placing a shunt in the firing line and running a line directly from the shunt terminals to the Type 319 Galvano-meter in the recorder. The ignition delay was measured by comparing the recorder timing lines to the current trace. Also, the firing time was measured by comparing the recorder timing lines to the current and pressure traces.

The 0 to 10,000 psi Wiancko transducer was fastened to the closed chamber by using a three-inch piece of stainless steel tubing. A stream of cold water was run on the closed chamber throughout the test to prevent the chamber from over-heating. The resistance of the bridge wires was measured on each cartridge just before functioning.

TEST RESULTS

The visual inspection of the cartridges indicated that they were all good, however, something loose was detected in most of the cartridges.

The average resistance of the double bridge wires was 0.08 ohms. This resistance value, even though it is near the upper tolerance given in the specification, is not considered to be a problem. In making this low of a resistance measurement, the contact resistance in the connector could account for the slightly high readings.

The energy in ampere-seconds required to fire the cartridges was random and higher than that required in the qualification tests. The higher energy levels are partly due to applying power to both bridge wires, and partly due to using currents near the minimum all-fire current. The higher average firing energy is still well within the capability of the firing system and therefore not a problem at this time. The random nature of the individual firing energy is of some concern and should be watched carefully during future tests. A graph showing the firing energy is shown in Figure 7.

The delay time between the application of the firing pulse and the rise of the pressure in the closed chamber is considerably longer than the same time obtained during the qualification tests. This increase in time is partly due to the low current levels used to function the cartridges. The delay times for cartridges 15, 30, 38 and 39 on bar graph given in Figure 8 are comparable to those in the qualification test. These cartridges were fired using only one bridge wire, thus providing higher current density per bridge wire.

There was no noticeable difference in the firing energy and ignition delay of the cartridges which were conditioned to -65°F and those which were conditioned to $+165^{\circ}\text{F}$.

The maximum chamber pressure obtained during this test was a little lower than those obtained during the qualification test. However, these pressures were still within the tolerance given in the specifications. The individual maximum pressures for each cartridge is shown in Figure 9.

During one of the hot firings a recording of the current, pressure and time was not obtained due to lack of paper on the recorder. This accounts for only 39 entries on the graphs. From visual observations of the firings the above cartridge functioned normally. The 22d column in Figure 9 shows an unusually low maximum pressure reading. The cartridge which produced this reading was from one of the newest lots tested, Lot 2-1, manufactured 7 July 1961.

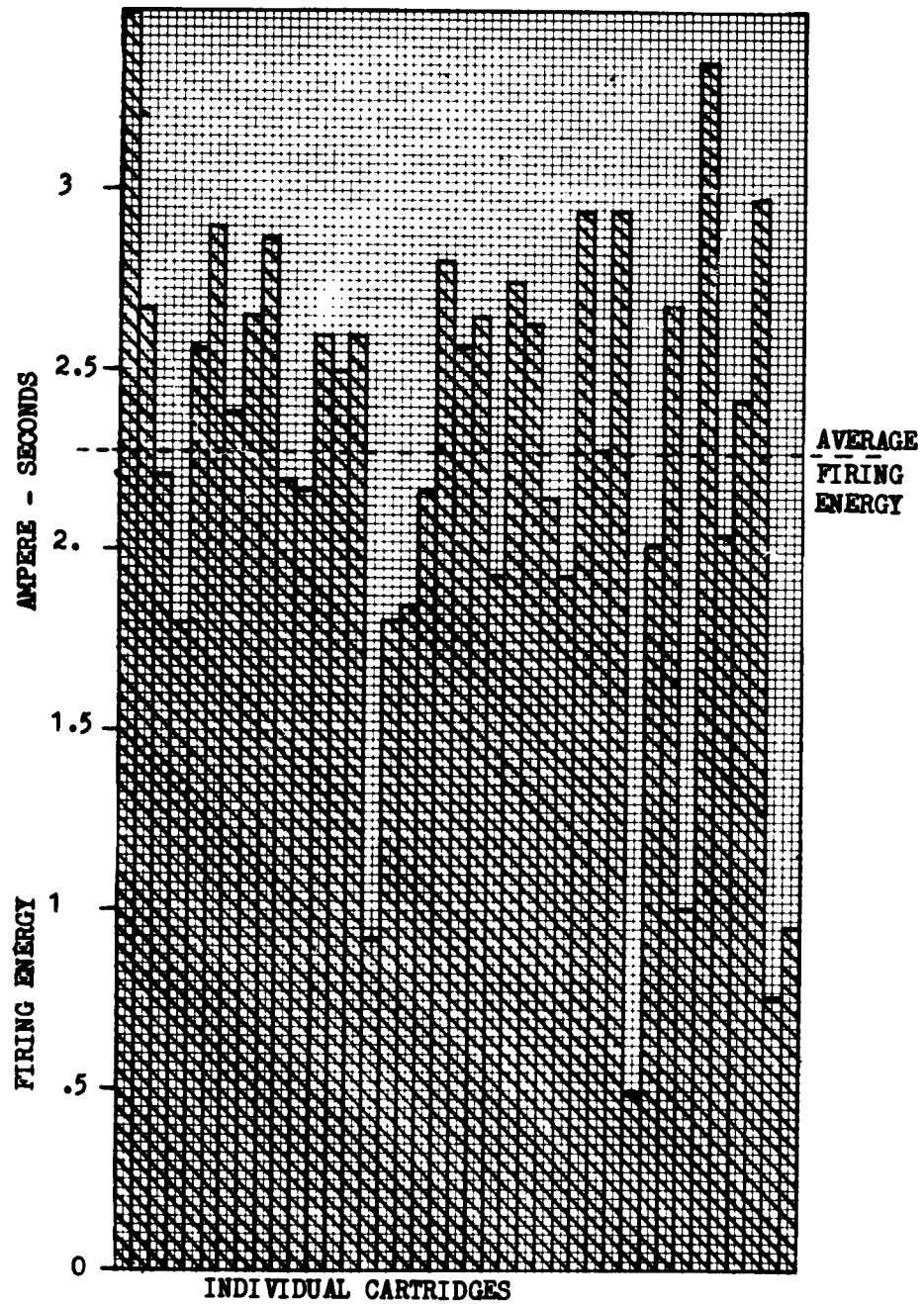


FIGURE 7. Individual Firing Energy

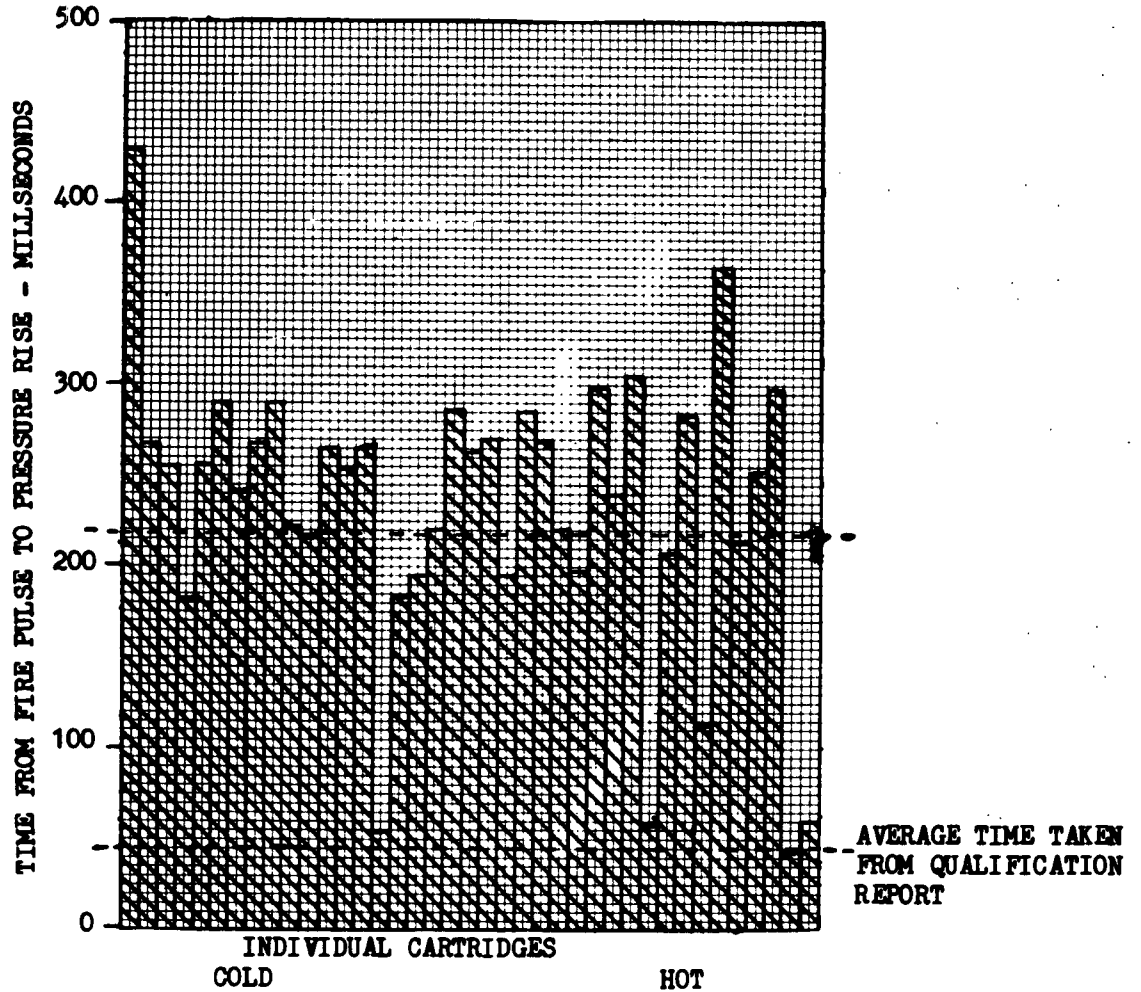


FIGURE 8. Individual Delays of Initial Pressure.

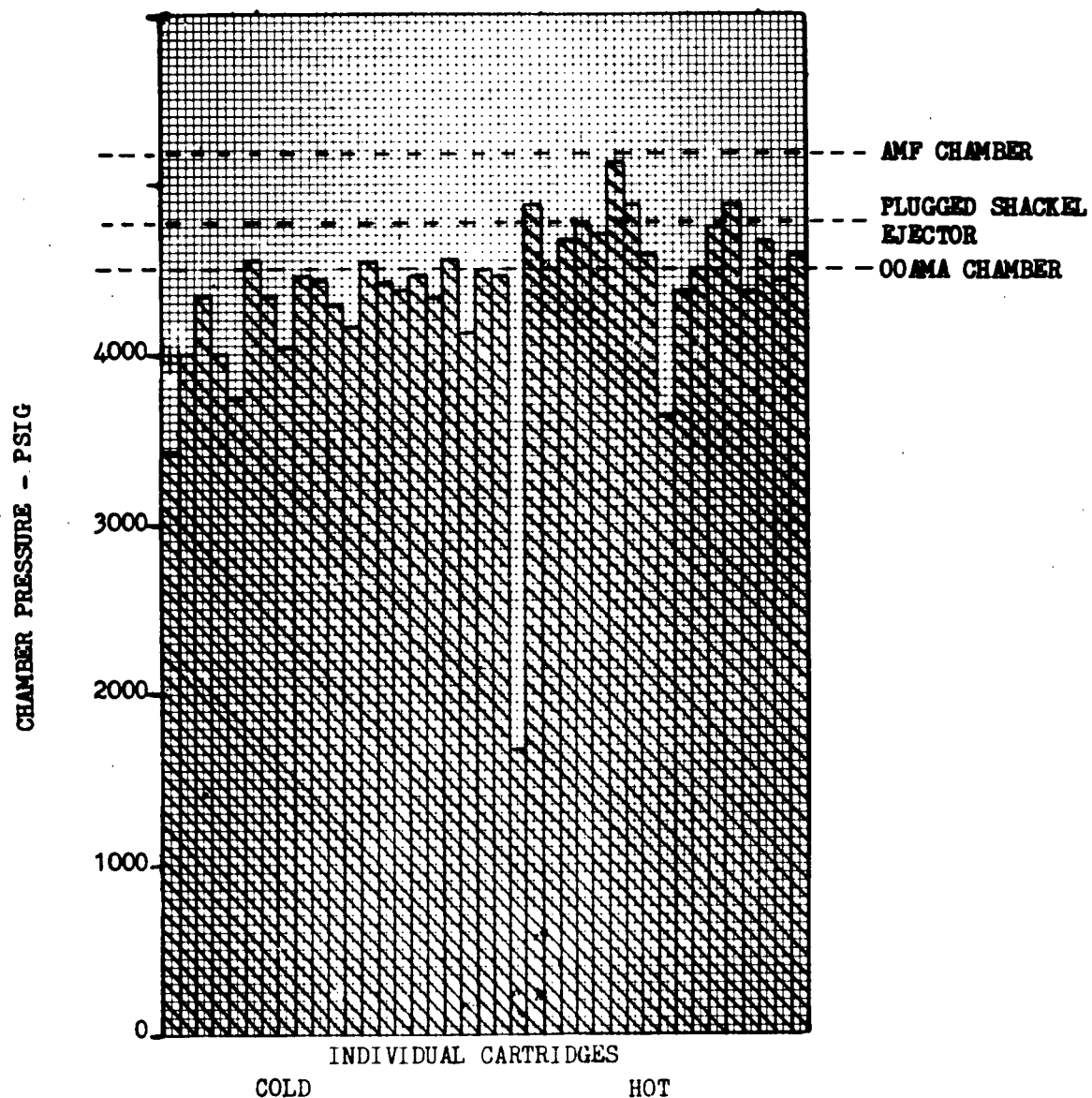


FIGURE 9. Maximum Chamber Pressures

The cartridges for the entire group of tests were from the following lots.

LOT	DATE OF MFG	QUANTITY
7	4-4-60	3
9	5-25-60	27
14	7-27-61	3
2-3	7-7-61	1
Unknown	Unknown	6

TABLE 1. Cartridges from Entire Group.

Curves which are typical of the traces obtained from the firings are shown in Figures 10 and 11.

Many of the cartridges in this test show about two hundred milliseconds delay in the pressure build-up. This condition is not a problem at this time since the delay was also present in some new cartridges during the qualification test.

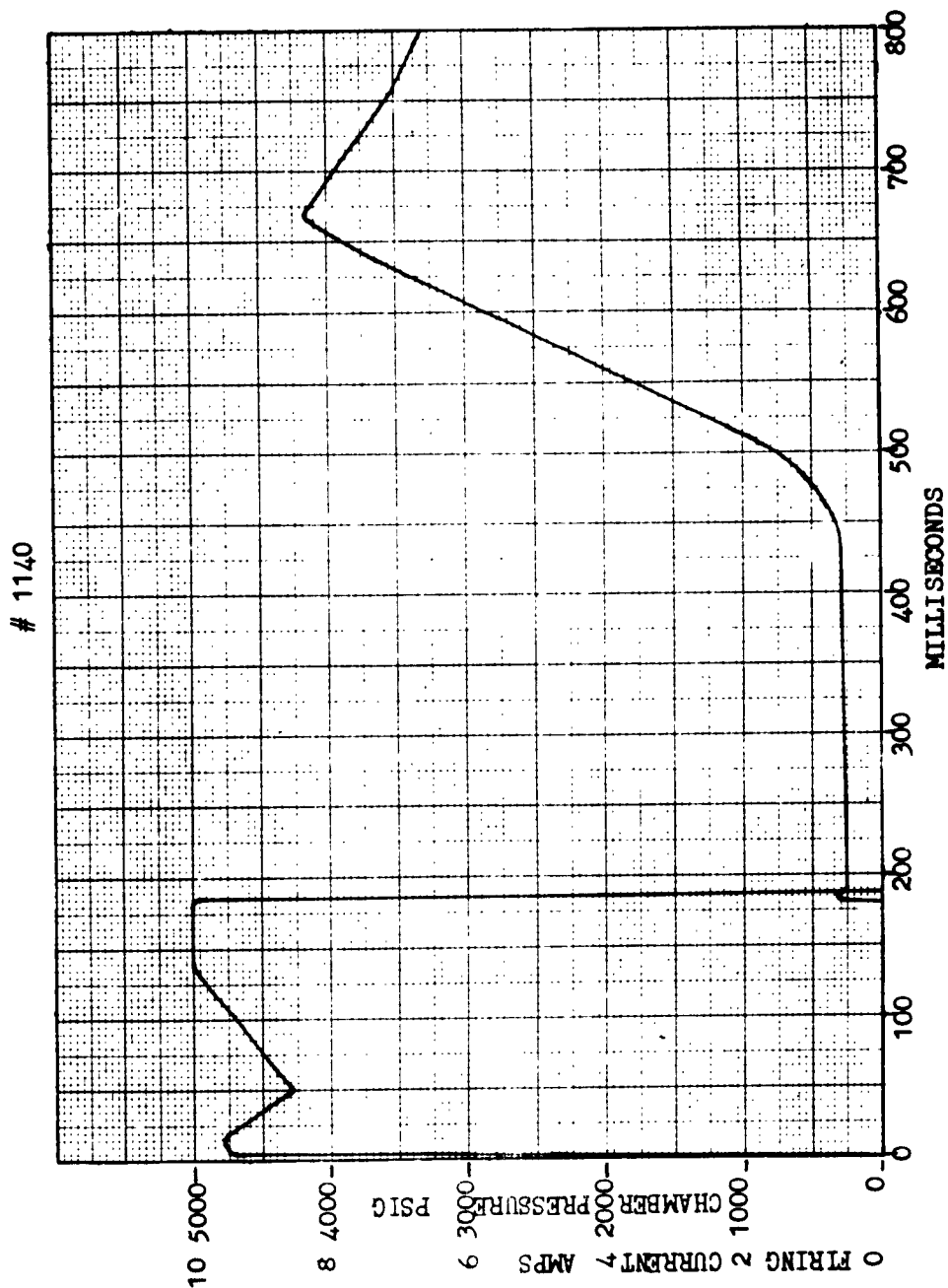


FIGURE 10. Current and Pressure Trace with Delay in Pressure Build-Up.

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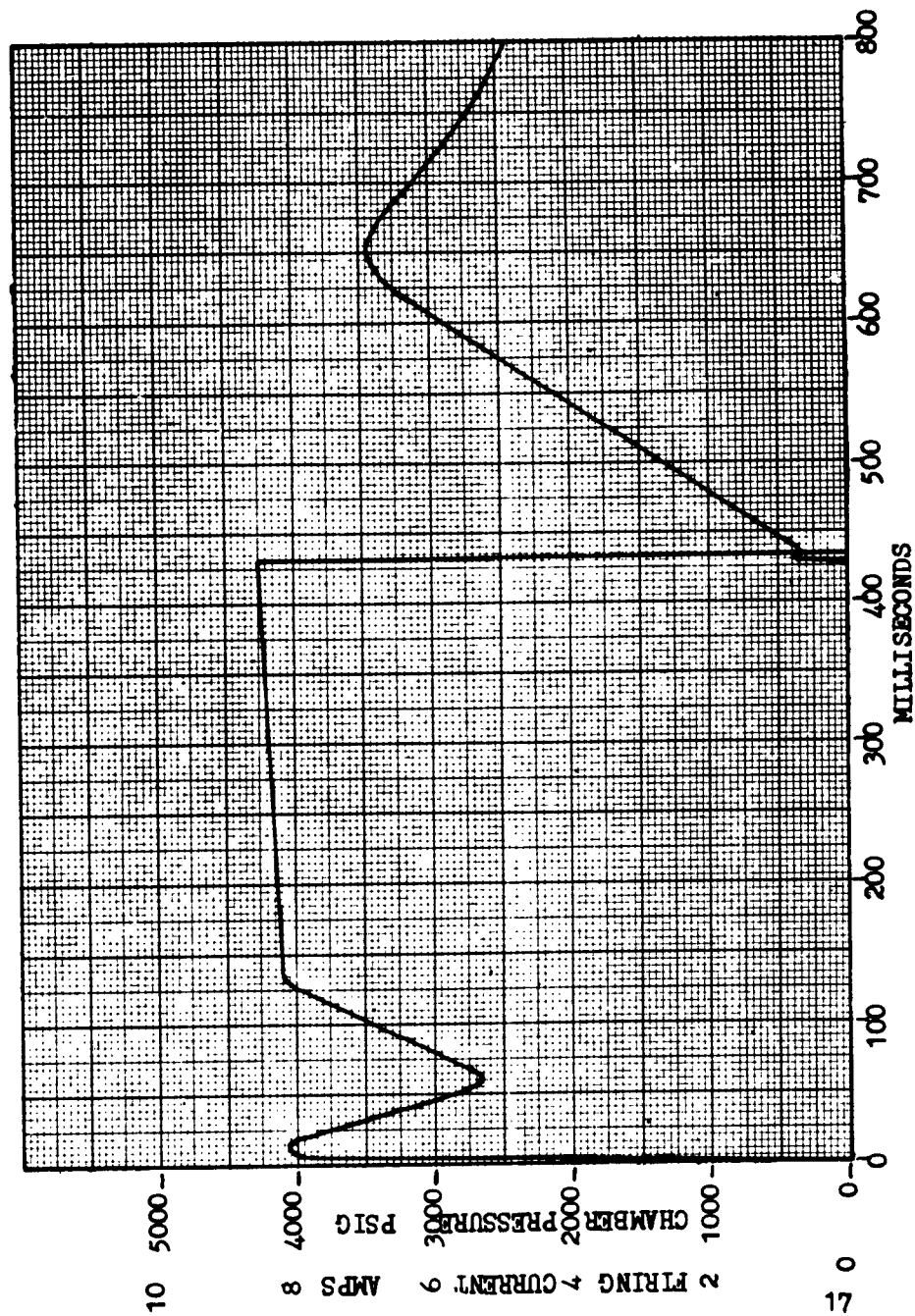


FIGURE 11. Current and Pressure Trace with Delay in Length of Firing Current.

CONCLUSIONS

The data from this test indicates that the Shackle Ejector Cartridge will remain serviceable when installed for up to two years in the GAM-72 Missile.

The differences between the average of the maximum readings obtained in this test and those obtained in the qualification tests are attributed to the differences in test equipment and testing methods. The random nature of the test data cannot be attributed to the test equipment and is therefore classed as a trend in the performance characteristics of the cartridges. In order to extend the performance trends of the cartridge, additional tests are required using cartridges which have received between two and three years of actual service in the GAM-72 Missile.

RECOMMENDATIONS

It is recommended that the service life of the Cartridge, Shackle Ejector, AFM 105-023-1100, be extended from one to two years.

It is also recommended that additional testing be conducted when the Shackle Ejector Cartridges have exceeded the recommended two year service life.

DISTRIBUTION LIST

- 3 Dep IG Directorate of Aerospace Safety, Hq USAF (AFIAS-G2),
Norton AFB, Calif
- 1 Hq USAF (AFSSS-AE), Wash 25, DC
- 2 AFLC (MCSW and MCAS), Wright-Patterson AFB, Ohio
- 1 AUL, Maxwell AFB, Ala
- 20 Hq DDC (TISIA-2), Arlington Hall Stn, Arlington 12, Va
- 1 Bureau of Naval Wpns (Code RMMO-5), Dep of the Navy, Wash 25, DC
- 1 CO, US Army Mtel Comd Field Safety Agcy, Charlestown, Ind
- 1 Safety Div (AMCAD-SA), US Army Mtel Comd, Wash 25, DC
- 1 US Army Ammunition Procurement and Sup Agcy (SMUAP-Q), Joliet, Ill
- 1 Hq AFSC (SCMMS-3), Andrews AFB, Wash 25, DC
- 1 CO, Picatinny Arsenal (Tech Info Lib), Dover, NJ
- 1 MATS (MAMSS/SBG), Scott AFB, Ill
- 1 Tech Lib (Code T2), US Naval Propellant Plant, Indian Head, Md
- 9 OOAMA(1-OOYIT, 1-OOYID, 1-OOYS, 1-OOYEO, 5-OOYEA), Hill AFB, Utah
- 1 SAC (DMLE), Offutt AFB, Nebr
- 1 BWR McDonnell Acft Corp, P O Box 516 St Louis 66, Mo

<p>AD</p> <p>2705th Airmunitions Wing (OQMA), Hill Air Force Base, Utah SERVICE LIFE TEST OF CARTRIDGE SHAKLE EJECTOR FOR THE GM-72 MISSILE, by Kenneth A. Kartchner, June 1963, 19p Incl. figures and tables. (OOT-TR-63-13) Unclassified Report</p> <p>These tests were initiated to determine the effects of operational service conditions on the useful life of the Cartridge, Shackle Ejector AMP 105-023-100. The tentative service life of the cartridge was one year. The cartridges tested were shipped to OQMA from the various locations in which they had been in service. The actual life in service had not exceeded two years on any of the test cartridges. The cartridges were fired in a closed chamber having a volume approximately equal to the shackle ejector in locked shut condition. The average of maximum pressures obtained in the tests were close to those obtained during the qualification test. However, the maximum pressures were more random in nature. The length of time between firing of the primer and the building up of pressure in the closed chamber was longer than that obtained during the qualification test. The results of the tests show that there was a slight decline in performance of the cartridges after two years of operational service. The test data shows that the cartridges which have been installed for two years are still serviceable. It is recommended that the service life of the cartridge be extended from one year to two years.</p>	<p>UNCLASSIFIED</p> <p>1. Cartridge Ejector I. Kenneth A. Kartchner</p>	<p>AD</p> <p>2705th Airmunitions Wing (OQMA), Hill Air Force Base, Utah SERVICE LIFE TEST OF CARTRIDGE SHAKLE EJECTOR FOR THE GM-72 MISSILE, by Kenneth A. Kartchner, June 1963, 19p Incl. figures and tables. (OOT-TR-63-13) Unclassified Report</p> <p>These tests were initiated to determine the effects of operational service conditions on the useful life of the Cartridge, Shackle Ejector AMP 105-023-100. The tentative service life of the cartridge was one year. The cartridges tested were shipped to OQMA from the various locations in which they had been in service. The actual life in service had not exceeded two years on any of the test cartridges. The cartridges were fired in a closed chamber having a volume approximately equal to the shackle ejector in locked shut condition. The average of maximum pressures obtained in the tests were close to those obtained during the qualification test. However, the maximum pressures were more random in nature. The length of time between firing of the primer and the building up of pressure in the closed chamber was longer than that obtained during the qualification test. The results of the tests show that there was a slight decline in performance of the cartridges after two years of operational service. The test data shows that the cartridges which have been installed for two years are still serviceable. It is recommended that the service life of the cartridge be extended from one year to two years.</p>	<p>UNCLASSIFIED</p> <p>1. Cartridge Ejector I. Kenneth A. Kartchner</p>
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